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depressions, and the other that following fire. In connection with the former, he distinguishes the usually recognized types of marsh and bog vegetation and states that the main distinction between the two is in the rate of growth, the slow rate of growth in bog plants being largely explained upon the basis of a dearth of mineral plant food in the substratum, which is also supposed to account for the presence of the same species upon the uplands in colder climates. No experimental evidence is given in support of this explanation. It is also rather surprising to be told that bog vegetation is "sometimes erroneously called xerophytic," after the almost endless discussion of bog xerophytes.

A deficiency of mineral plant food is also given as an explanation of the slow progress toward mesophytism of the pine forests upon sandy uplands. Leaching is supposed to prevent the accumulation of any considerable amount of plant food near the surface of the ground. This may possibly hold for the sandy plains, but if so it is difficult to see why it should not also apply to the pure sand of the dunes, where mesophytic forests develop rather quickly and where the conifers are soon largely replaced by deciduous species.

In discussing the influence of fire upon forest establishment, the error is made of stating that the cones of *Pinus Banksiana* remain closed and attached to the tree for many years, opening and discharging their seed after burning. Closer observation would have shown that the cones that remain for several years upon this pine open and discharge their seed very promptly upon ripening, and that the tree is in no wise dependent upon fire for its seeding.—GEO. D. FULLER.

Fairy rings and their effect on vegetation.—Of more than ordinary interest is a recent paper on fairy rings by SHANTZ and PIEMEISEL.¹⁷ Before taking up their own researches, they present an excellent summary of past studies and theories concerning them, as well as a table of the fungi that have been reported as being responsible for rings. Some fungi, as *Agaricus tabularis*, are very destructive to grass and other vegetation; some, as *Calvatia* and *Lycoperdon*, are beneficial; and some, as *Lepiota*, have little effect of any sort. Striking conclusions are given relative to the age of rings. The conditions in eastern Colorado are not very favorable, either for spore germination or mycelial advance; in favorable years there may be a mycelial advance from the ring center of 30–60 cm., as compared with almost no advance at all in dry years. Some of the rings are very large, and from the growth measurements that have been made, a few are estimated to be 400–600 years old. Where vegetation is stimulated, it was concluded from careful study that this is due to the reduction of nitrogenous organic matter to available nitrates and ammonia salts, and to the subsequent decay of the fungous filaments. Deterioration or death of vegetation are attributed mainly to drought, caused by the prevention of water

¹⁷ SHANTZ, H. L., and PIEMEISEL, R. L., Fungous fairy rings in eastern Colorado and their effect on vegetation. Jour. Agric. Research 11:191–246. pls. 21. figs. 15. 1917.

penetration by the masses of fungal filaments. Vegetation thus destroyed is replaced, after the death of the fungous, first by weeds, then by short-lived grasses, and eventually by the original short-grass cover.—H. C. COWLES.

Foreign pollen on Cycas.—It is well known that in some cycads the ovules reach the maximum size for the species whether pollination has occurred or not; while in others the ovules, if not pollinated, soon disorganize. *Cycas Rumphii* belongs to the latter category.¹⁸ Female plants of this species are very abundant in Ceylon, but no male plants have been observed for several years. In localities where male cones of *Encephalartos* and *Macrozamia* are abundant, the pollen of these species germinates in the pollen chamber of *Cycas Rumphii* and causes the ovule to develop to the full size. Since the pollen of cycads germinates readily in artificial solutions, it is not strange that pollen of one species should germinate in the pollen chamber of another. In this case, however, no fertilization takes place, and mature seeds, which should show the embryo in an advanced stage of development, showed no trace of an embryo. A few years ago the reviewer pollinated *Stangeria* with *Zamia* and obtained three large seeds, which were planted but failed to germinate. It is possible that the pollen stimulated growth but failed to fertilize the egg, so that, as in *Cycas Rumphii*, no embryo was produced.—CHARLES J. CHAMBERLAIN.

Water culture.—In a critical discussion of the water culture method of studying growth phenomena, STILES¹⁹ calls attention to the limitations of the method. He points out the great complexity of the factors involved, and applies BLACKMAN's idea of limiting factors. The difficulty of analyzing the results of such experiments, due to the interaction of so large a complex of factors, few of which, even those whose action is under investigation, can be controlled, is made clear. Some factors, as for instance the influence of the respiratory activity of the roots on the culture solutions, have been neglected in all water culture work. The variability of individual plants is so great that a large amount of labor is required to secure results even with a low degree of accuracy. Nevertheless, for certain kinds of problems it may be the only method available.—CHARLES A. SHULL.

Grasses of Illinois.—Miss MOSHER²⁰ has published a manual of the grasses of Illinois, recognizing 204 species in 63 genera, over one-fifth of the species being recorded for the first time as occurring in Illinois. The analytical keys, descriptions, and numerous text cuts make the bulletin very useful in the recognition of the grass flora.—J. M. C.

¹⁸ LE GOC, M. J., Effect of foreign pollination on *Cycas Rumphii*. Ann. Roy. Bot. Gard. Peradeniya 6:187-194. pl. 13. 1917.

¹⁹ STILES, WALTER, On the interpretation of the results of water culture experiments. Ann. Botany 30:427-426. 1916.

²⁰ MOSHER, EDNA, The grasses of Illinois. Univ. Ill. Agric. Exper. Sta. Bull. 205. pp. 261-425. figs. 287. 1918.